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1. Agency Use Only (Leave blank).		2. Report Date. March 1993		3. Report Type and Dates Covered. Final - Proceedings	
4. Title and Subtitle. Geology and Geophysics at ARSRP Sites A and C				5. Funding Numbers. Program Element No. 0601153N Project No. 03204 Task No. 040 Accession No. DN251004 Work Unit No. 571520603	
6. Author(s). Jerald W. Caruthers, and Brian Tucholke ¹					
7. Performing Organization Name(s) and Address(es). Naval Research Laboratory Ocean Acoustics Branch Stennis Space Center, MS 39529-5004				8. Performing Organization Report Number. NRL/PP/7175-93-0033	
9. Sponsoring/Monitoring Agency Name(s) and Address(es). Office of Naval Research 800 N. Quincy St. Arlington, VA 22217-5000				10. Sponsoring/Monitoring Agency Report Number. NRL/PP/7175-93-0033	
11. Supplementary Notes. Published in Institute of Geophysics and Planetary Physics. ¹ Woods Hole Oceanographic Inst., Woods Hole, MA 02543					
12a. Distribution/Availability Statement. Approved for public release; distribution is unlimited.				12b. Distribution Code.	
13. Abstract (Maximum 200 words). Extensive, high-quality, low-frequency acoustic scattering data were collected on the Acoustic Reverberation Special Research Program (ARSRP) Reconnaissance Cruise on the western flank of the Mid-Atlantic Ridge in the summer of 1991. To support the analysis of these acoustic data a geological and geophysical (G&G) survey was conducted in the summer of 1992. Among the data taken in this latter cruise were swath bathymetry, single channel seismics, and sidescan sonar. These data are not only critical to the analysis of the acoustic data, but also in planning a fine-scale G&G survey and a fine-scale acoustic reverberation experiment in the region in the summer of 1993. Several sites identified by the previous acoustics and G&G cruises are planned for the detailed work in this summer's cruises. Among these sites are the ARSRP-designed Sites A and C. Site A is a priority site for the future fine-scale work and C is a site alternate to other priority sites. Presented here are displays of relevant G&G data for these two sites with some interpretation and analysis.					
14. Subject Terms. Bottom scattering, reverberation				15. Number of Pages. 8	
				16. Price Code.	
17. Security Classification of Report. Unclassified		18. Security Classification of This Page. Unclassified		19. Security Classification of Abstract. Unclassified	
				20. Limitation of Abstract. SAR	

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Spring ARSRP Research Symposium
23-25 March, 1993
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GEOLOGY AND GEOPHYSICS AT ARSRP SITES A AND C

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ABSTRACT

Extensive, high-quality, low-frequency acoustic scattering data were collected on the Acoustic Reverberation Special Research Program (ARSRP) Reconnaissance Cruise on the western flank of the Mid-Atlantic Ridge in the summer of 1991. To support the analysis of these acoustic data a geological and geophysical (G&G) survey was conducted in the summer of 1992. Among the data taken in this latter cruise were swath bathymetry, single channel seismics, and sidescan sonar. These data are not only critical to the analysis of the acoustic data, but also in planning a fine-scale G&G survey and a fine-scale acoustic reverberation experiment in the region in the summer of 1993. Several sites identified by the previous acoustics and G&G cruises are planned for the detailed work in this summer's cruises. Among these sites are the ARSRP-designated Sites A and C. Site A is a priority site for the future fine-scale work and C is a site alternate to other priority sites. Presented here are displays of relevant G&G data for these two sites with some interpretation and analysis.

INTRODUCTION

The purpose of this summary is to provide data displays and interpretation for ARSRP-designated Sites A and C. It will serve as a reference during the execution of the fine-scale acoustics reverberation experiments at Sites A and C (if the latter becomes an experimental site.) For general discussions of the data collected during the G&G survey of 1992, the reader is referred to the collection of works published as abstracts for the ARSRP Fall 1992 Symposium in Woods Hole, MA, 18-20 November 1992 [1,2].

CRUISE TRACKS AND BATHYMETRY

The cruise tracks of the R/V Maurice Ewing (EW9208) for the dates 27-30 July and 1 August 1992 are shown in Figure 1. The bathymetry shown in the figure is derived from the Hydrosweep swath bathymetry system and is contoured at 50 m. The locations of Sites A and C are labelled in the figure as are selected reference points along the tracks. These latter points are placed to allow matching of the tracks of Fig. 1 with the seismic traces of Figures 2 and 3.

The water depth to the surface of the sediment pond east of Site A is 4400 to 4450 m. Site A is an outside corner and is characterized by a series of ridges with a spacing of about 5.5 km. East-facing slopes are steeper than west-facing slopes, and they probably consist of a series of fault scarps. Basement rocks are probably basaltic and are most likely sediment-covered on all but the steepest slopes. At Site A the summit ridge rises from 4400 m to about 3400 m in about 11 km, giving rise to an average slope of about 5 deg.

The depth of the sediment pond west of Site C is 4450 to 4500 m. Site C is an inside corner and, in contrast to Site A, is characterized by a large quasi-circular block of probable gabbros and serpentinites. The relief of Site C is characterized by a steeper northern part (11 deg avg) and a less steep southern part (7 deg avg). The highest average slope in the region is found on the western slope of the inside corner just north of Site A (26 deg avg).

SINGLE CHANNEL SEISMIC DATA

Seismic reflection profiles were digitally recorded using an 80 in³ watergun (140 Hz peak output) and a single-channel streamer. Figure 2 shows seismic reflection profiles taken along track segments on 27-30 July. Figure 3 shows the seismic data for several track segments on 1 August. The horizontal line across the middle of each profile is at a depth of approximately 4400 m. The time interval between horizontal lines is 0.8 sec or about 600 m in the water column (1500 m/s). Sediment fill in the flat ponded areas is clearly observed. We assume a mean sediment sound velocity in these areas of 1900 m/s. At this velocity the deeper regions of the sedimented ponds attain a thickness of about 500 m. There are thin, flat sedimented ponds in some valleys between smaller ridges in the profiles, but sediments on the ridges themselves can not be resolved in these data.

Sites A and C are indicated in the seismic profiles. They were chosen, in part, because they are at the edges of the large ponds (50 to 100 nm²) and they extend up the slopes from the ponds. In the pond areas we are mainly interested in sediment thickness at the pond edges at these sites and how the sediments thin out as the ridges rise out of the ponds. The profiles in Figure 4 show increased resolution seismic records of these more interesting sedimented areas. These profiles will be important for detailed analysis of acoustic scattering at the edges of the ponds.

SIDESCAN SONAR DATA

Sidescan sonar data were acquired with the Hawaii MR1 system (11/12 kHz) over a total swath width of 20 km (10 km each side). Figure 5 shows sidescan data for Sites A and C. The distinction between the top and bottom diagrams is look direction for the

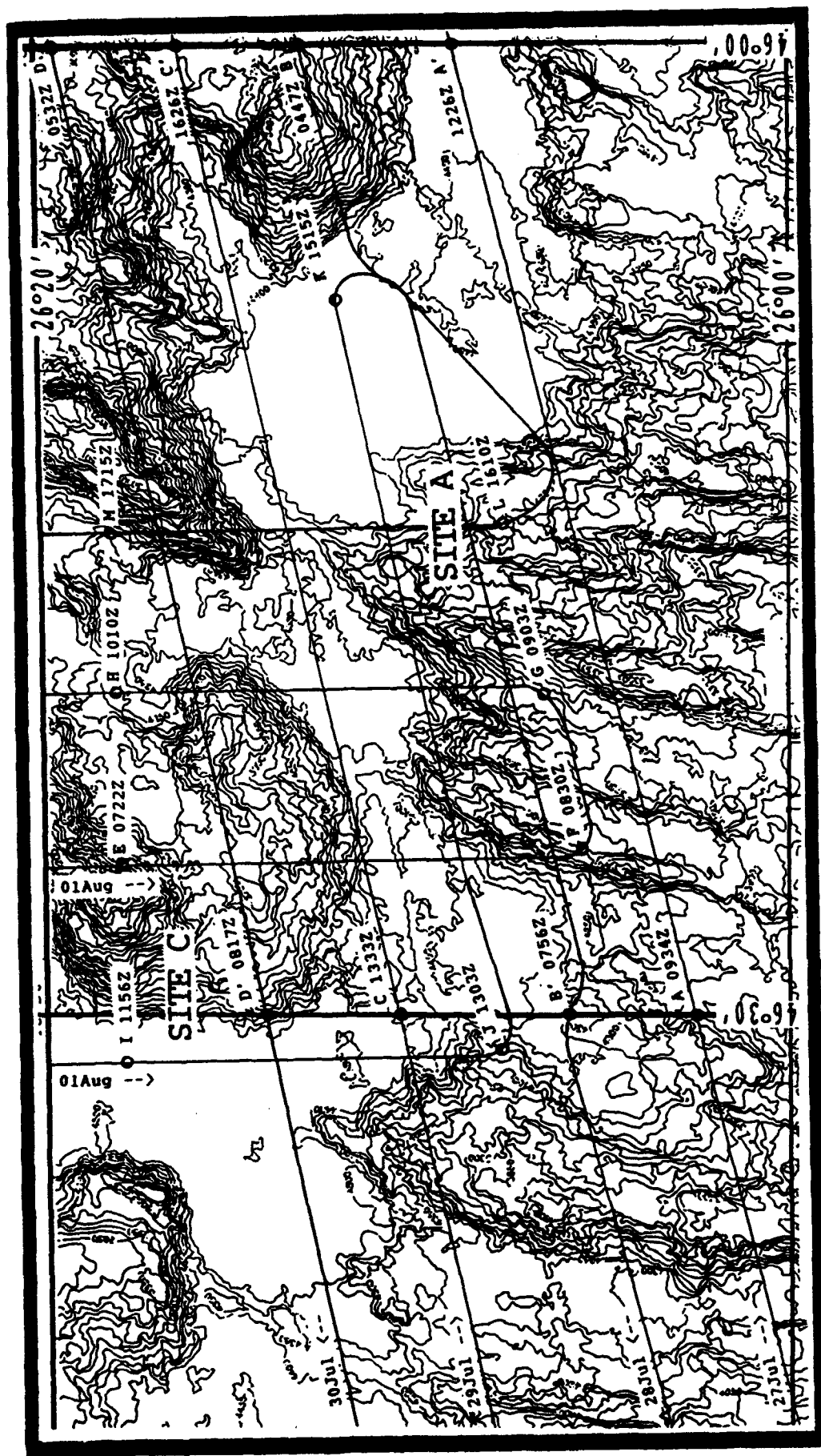


FIGURE 1: Tracks of the RV Maurice Ewing (EW9208) for 27-30 July and 1 August 1992 superimposed on Hydrosweep bathymetry (in meters) contoured at 50 m.

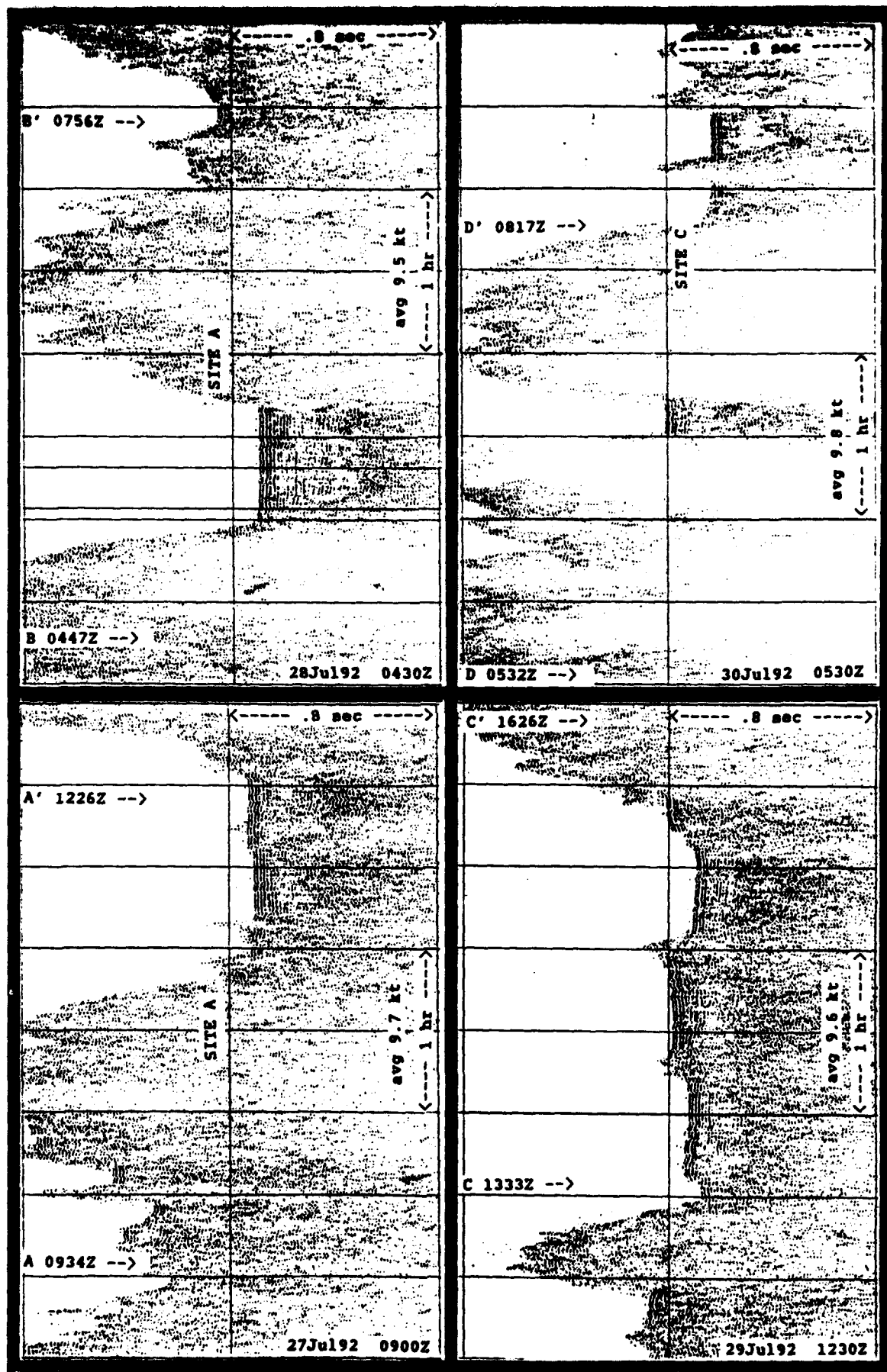


FIGURE 2: Single-channel seismic profiles (0.8 sec record) taken 27-30 July 1992 in area of Sites A & C

sonar. Site A shows clear scattering from the east-facing slopes that are prevalent at that site. Low-frequency acoustic data also indicates prominent scattering from the same features. (The reader is referred to acoustic reverberation maps and plots in the accompanying papers [3,4].) Site C shows a distinctly different character in both the sidescan and low-frequency acoustics data. This distinction is characteristic of the differences in geomorphology, texture, and seafloor composition between inside- and outside-corners crusts. The weakest scattering is clearly from the ponded areas.

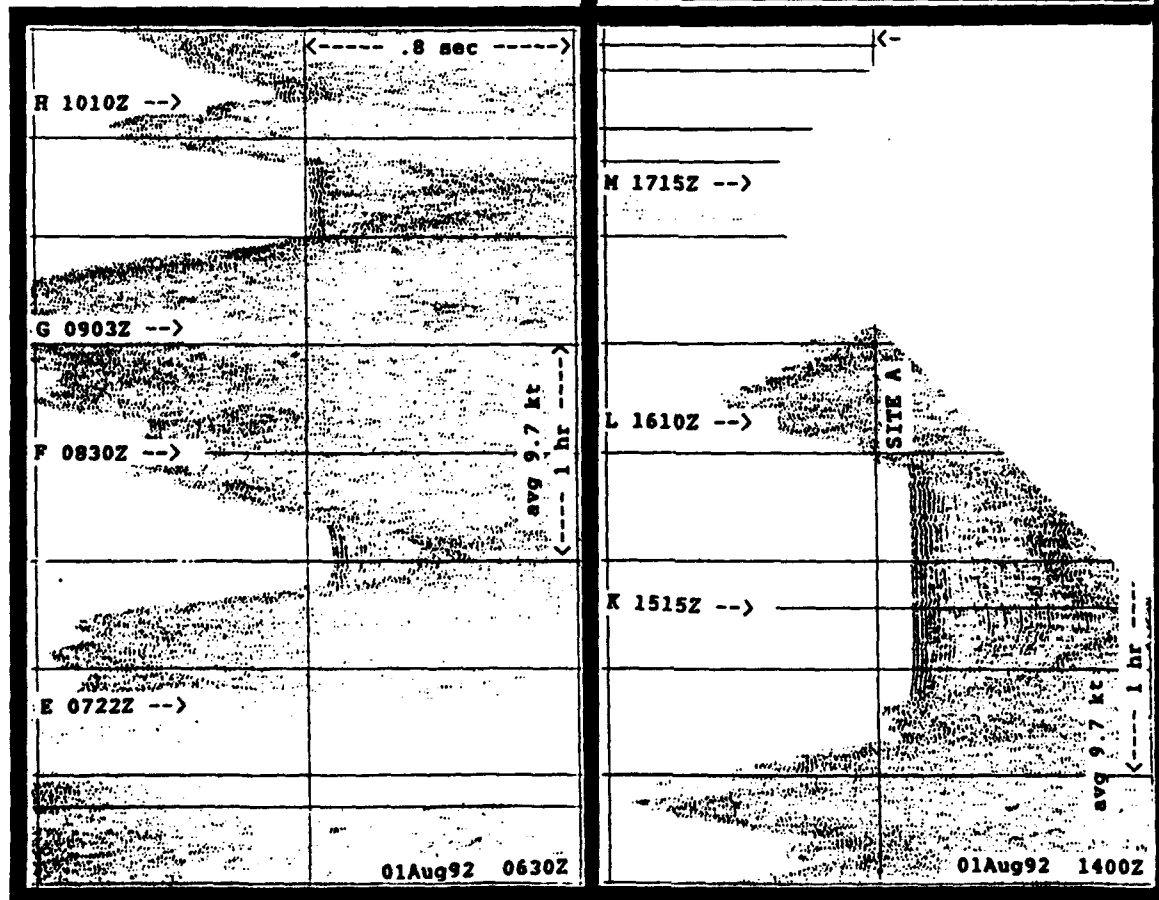


FIGURE 3: Single-channel seismic profiles (0.8 sec record) taken 1 August 1992 in area of Sites A & C

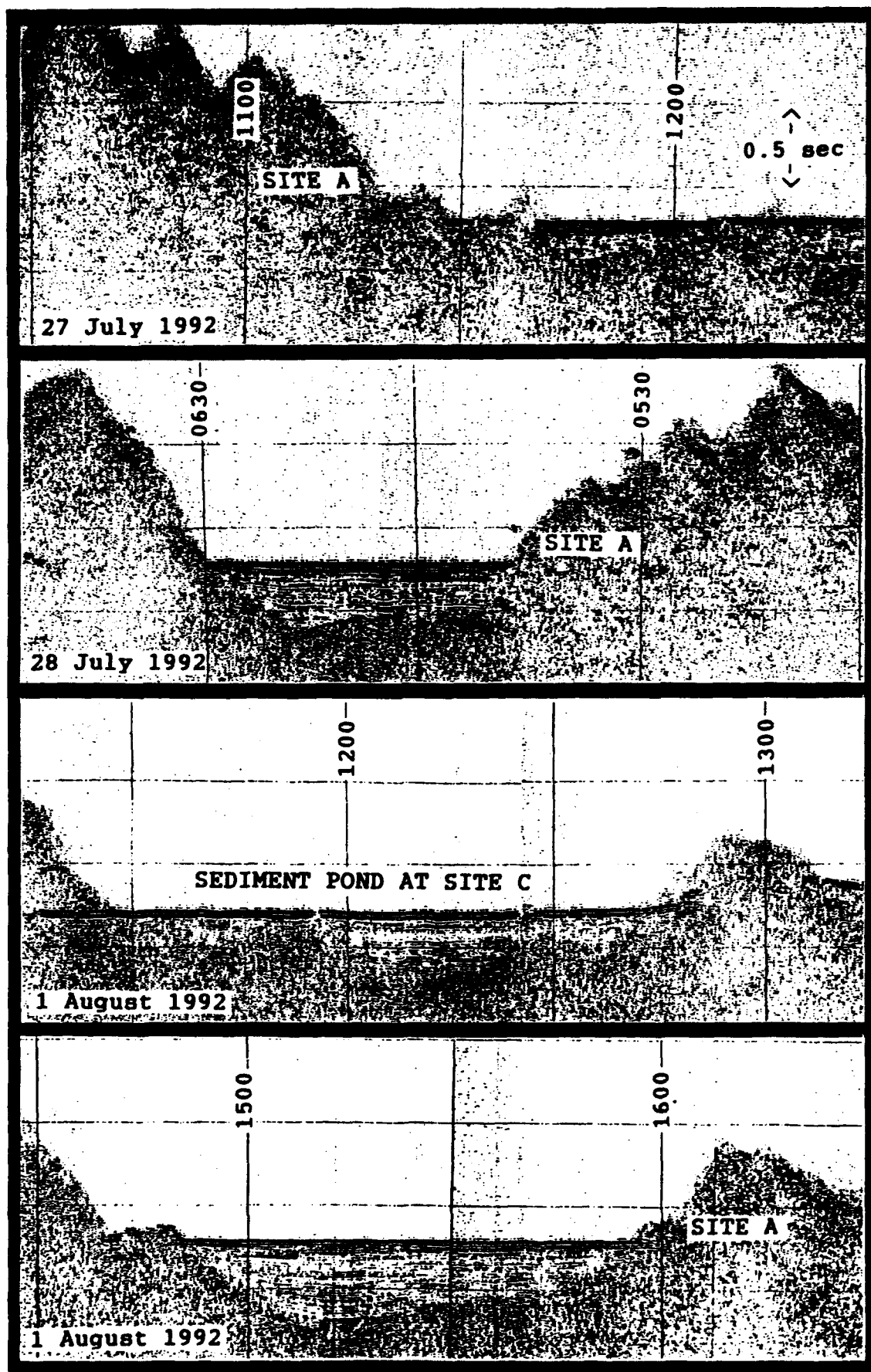


FIGURE 4: Single-channel seismic profiles (0.5 sec record) for selected tracks at Sites A & C.

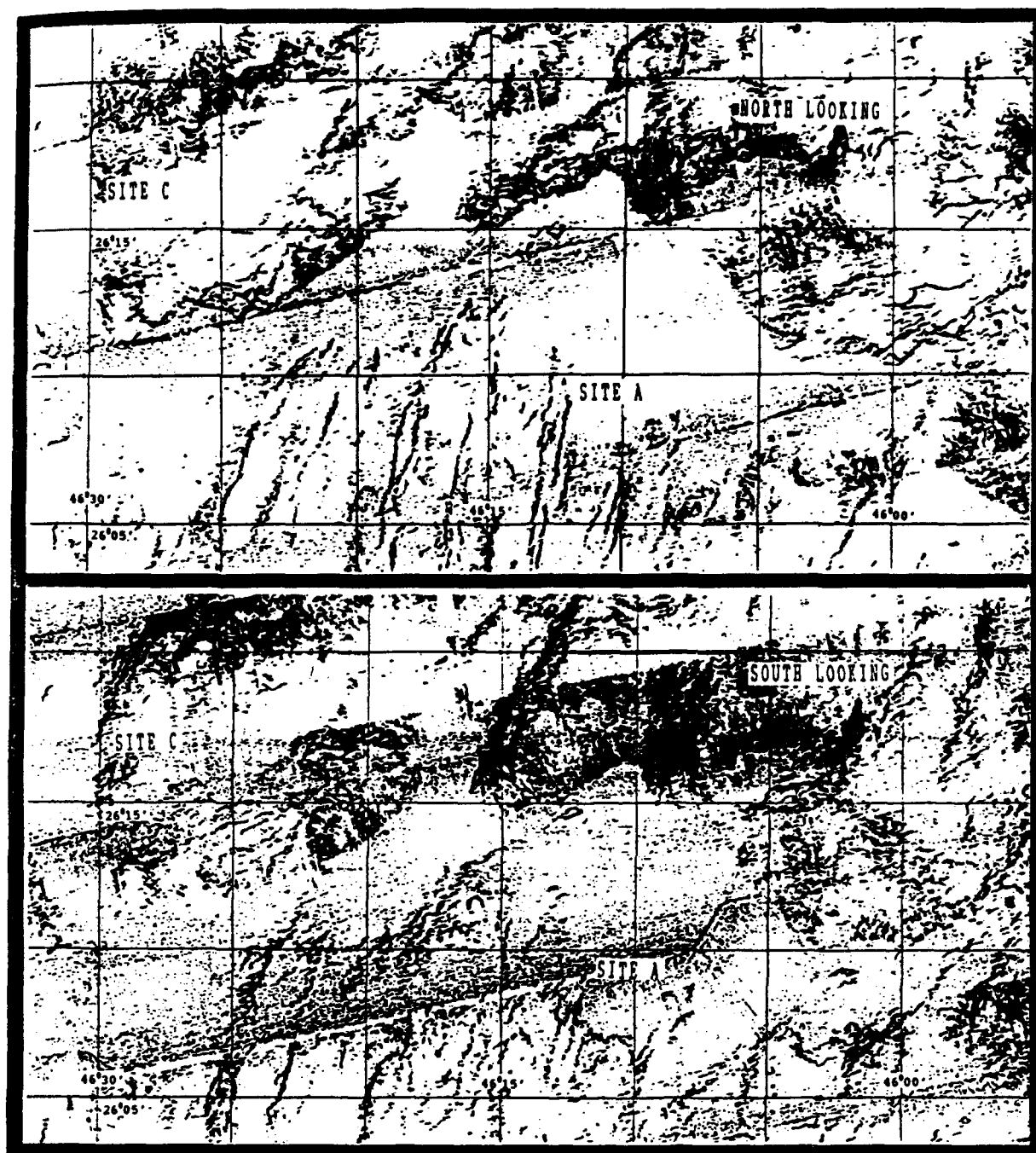


FIGURE 5: North and South looking sidescan sonar images at Sites A & C.

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